Asking more from wind and solar power

Kory Hedman, Program Director

Electric Power Sector Products

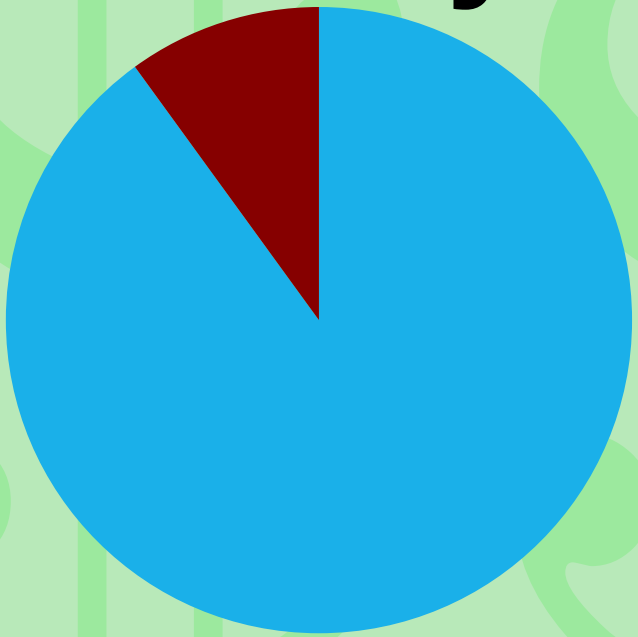
Today

Renewables: 15% of all Electric Energy

Goals: >50%

Electric Power Sector Products

Today



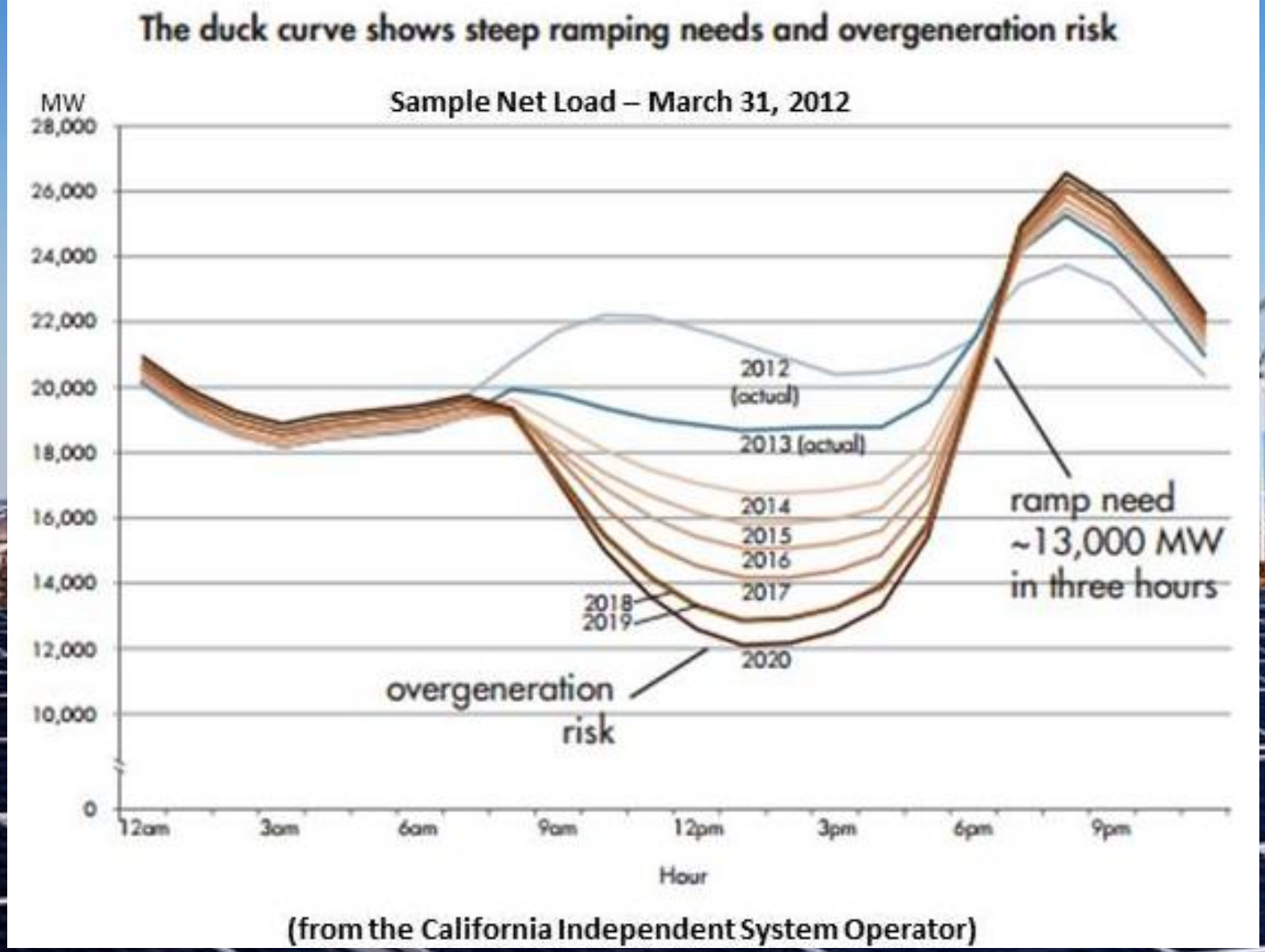
Wind and Solar:
Limited provision of
ancillary services

Goals: ?

Energy

Ancillary Services

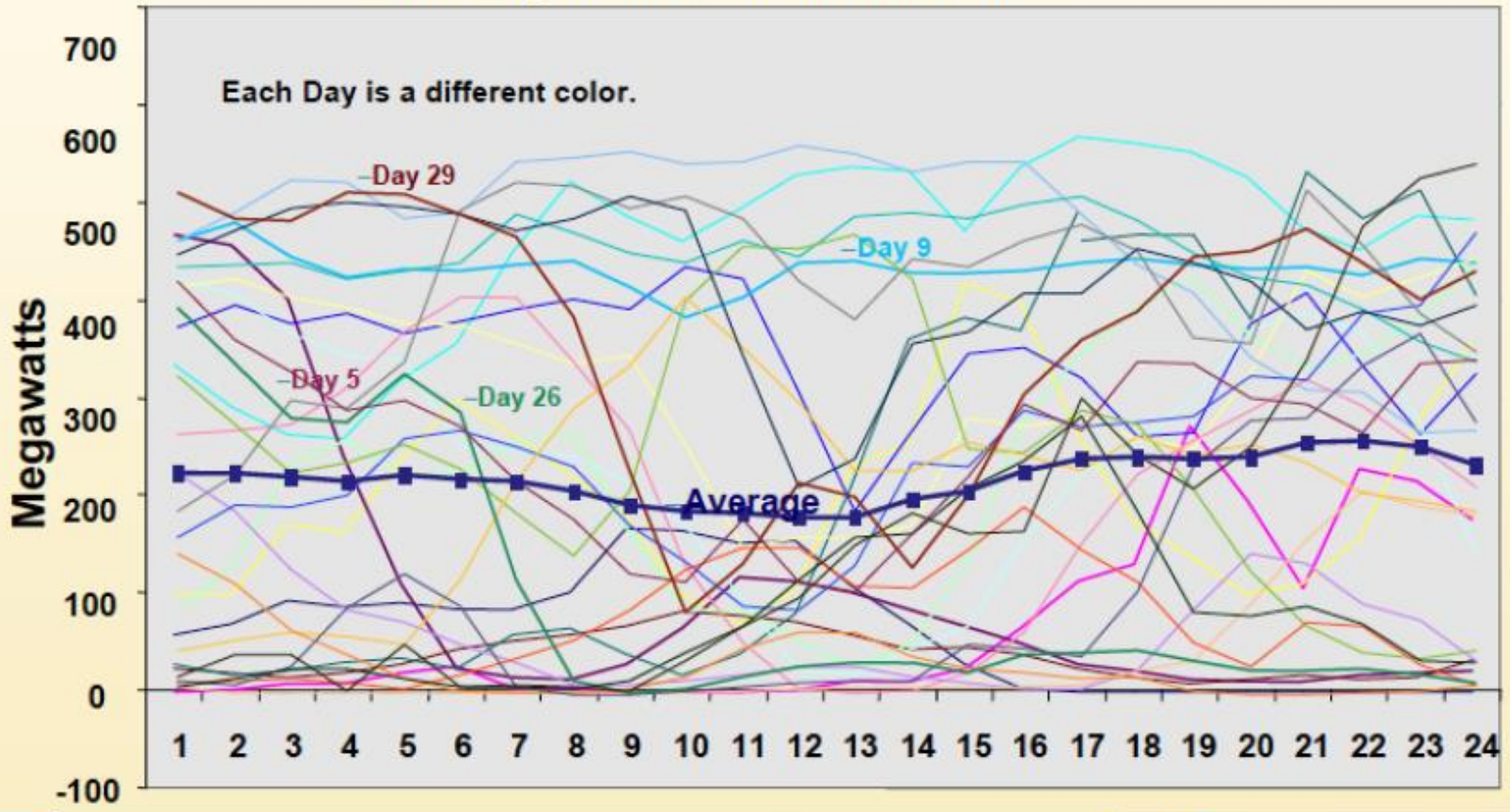
Challenge: Renewable Variability



Challenge: Renewable Variability and Uncertainty

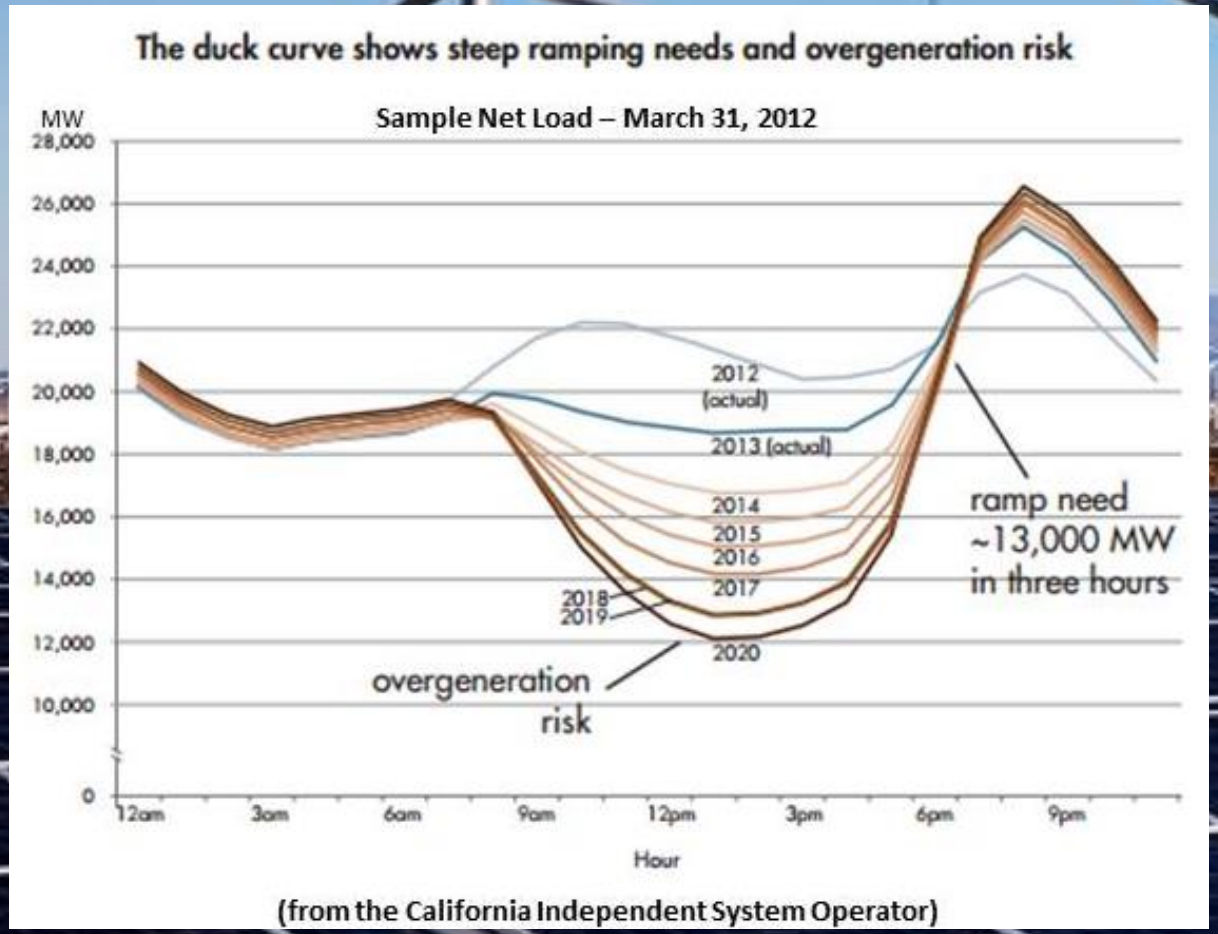
Tehachapi Wind Generation in April – 2005

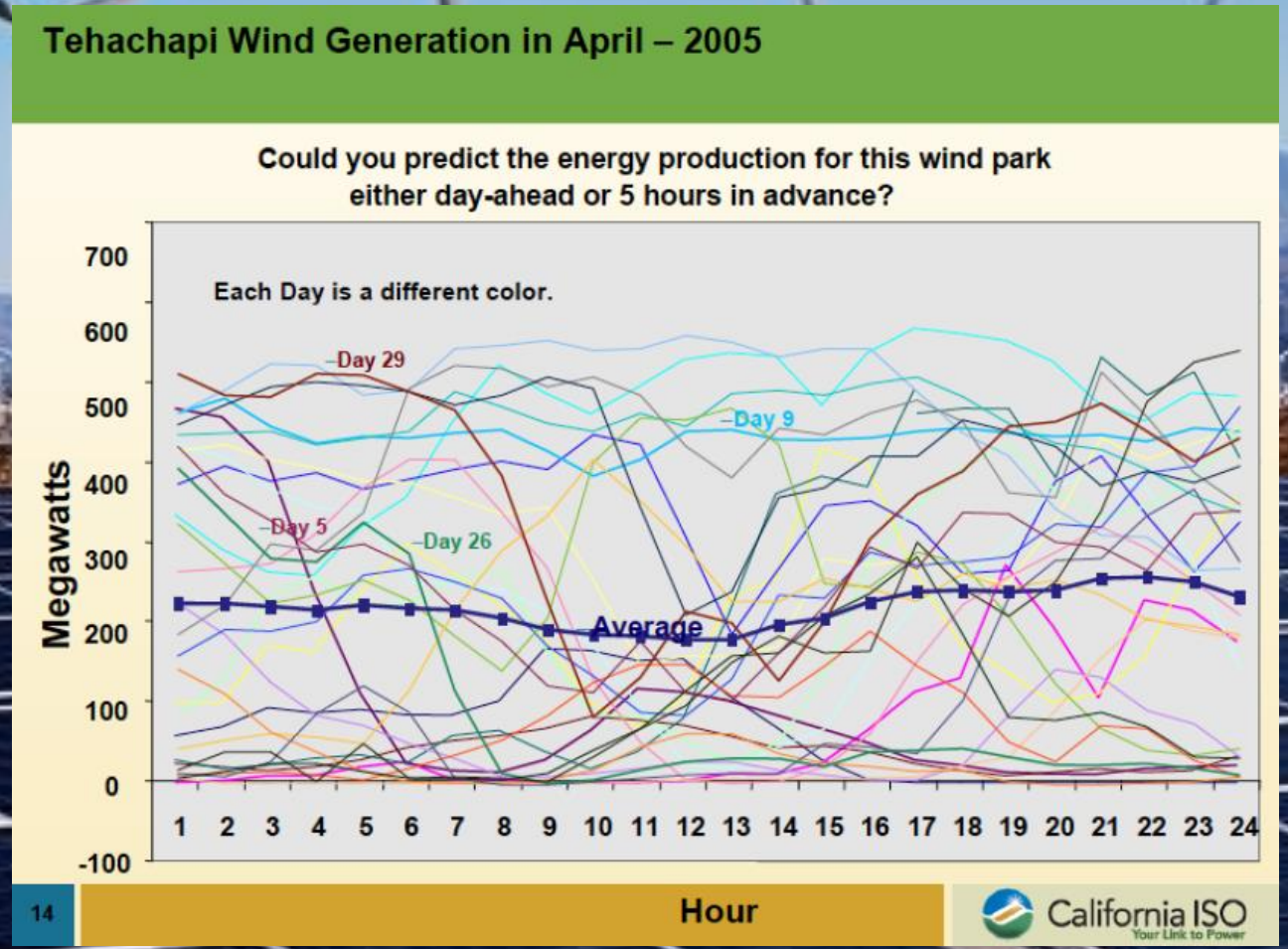
Could you predict the energy production for this wind park either day-ahead or 5 hours in advance?



California ISO
Your Link to Power

Challenge: Renewable Variability and Uncertainty





Wind and solar have crossed a tipping point

Onshore wind

Median cost: 4.5 ¢/kWh
Best regions: 3.0 ¢/kWh

Solar

Median cost: 4.5 ¢/kWh
Best regions: 3.5 ¢/kWh

Offshore wind

European bids now at ~5 ¢/kWh

All costs are without subsidies.

Lazard's Levelized Cost of Energy Analysis – Version 11, 2017, https://www.ft.com/content/f5b164a6-20f8-11e7-b7d3-163f5a7f229c

Energy and Ancillary Services

Energy

Renew 80%

Fossil Fuel 10%

Nuclear 10%

Ancillary Services

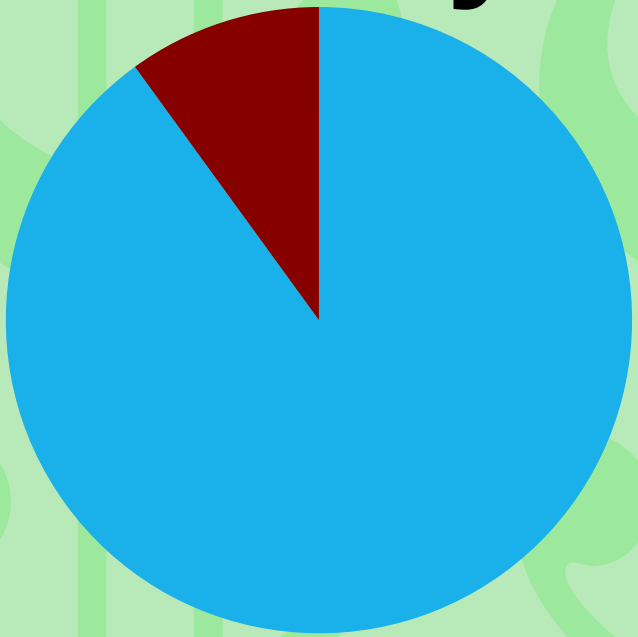
Conventional Generators

More Renewables = More Ancillary Services

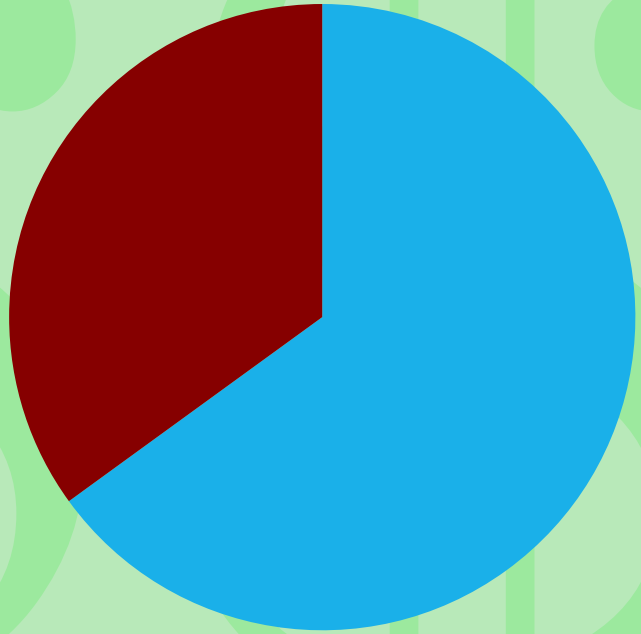
Flexible Load / Storage

Electric Power Sector Products and Revenue

Today



Future

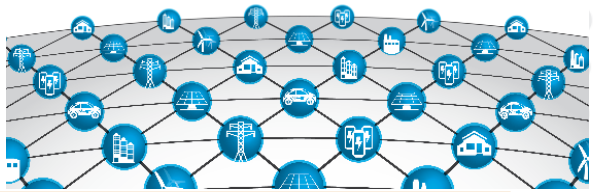


Energy

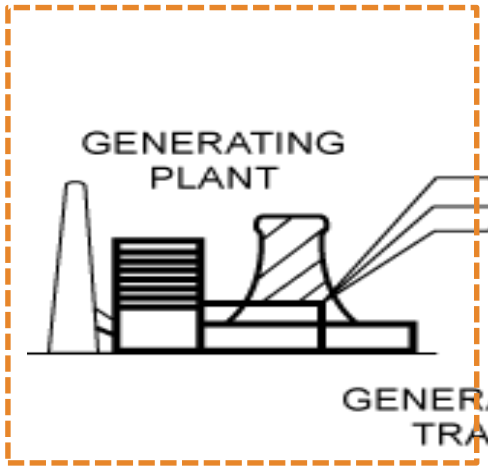
Ancillary Services

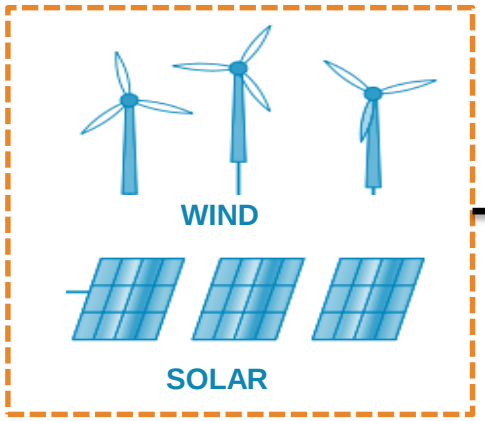
Ongoing ARPA-E Program

NODES

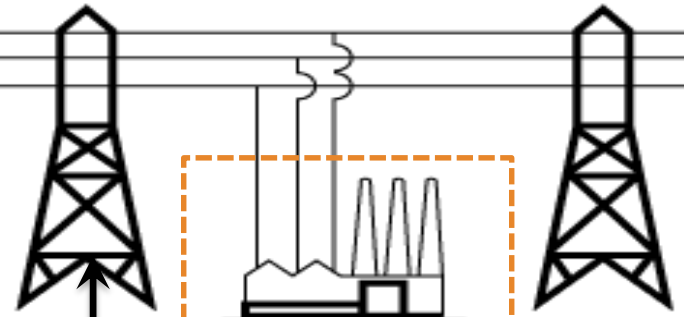


Bulk Generation
Dispatch, Set-points & Inertia

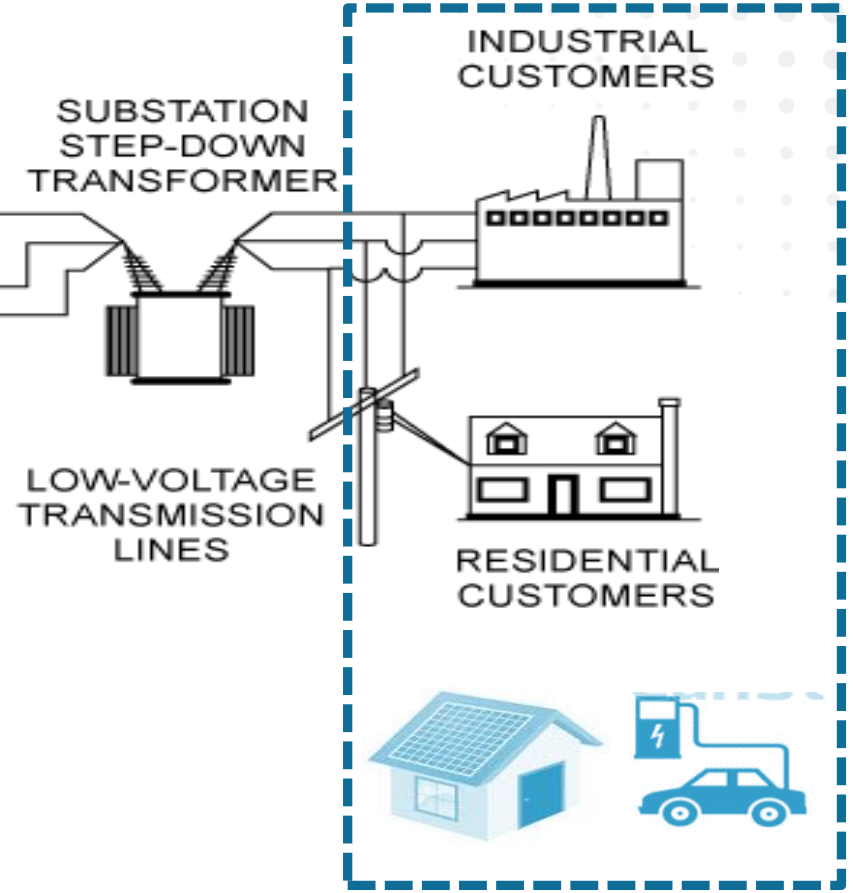




Bulk Renewables
Curtailment



Industrial Load
Bulk DR (hour-day)



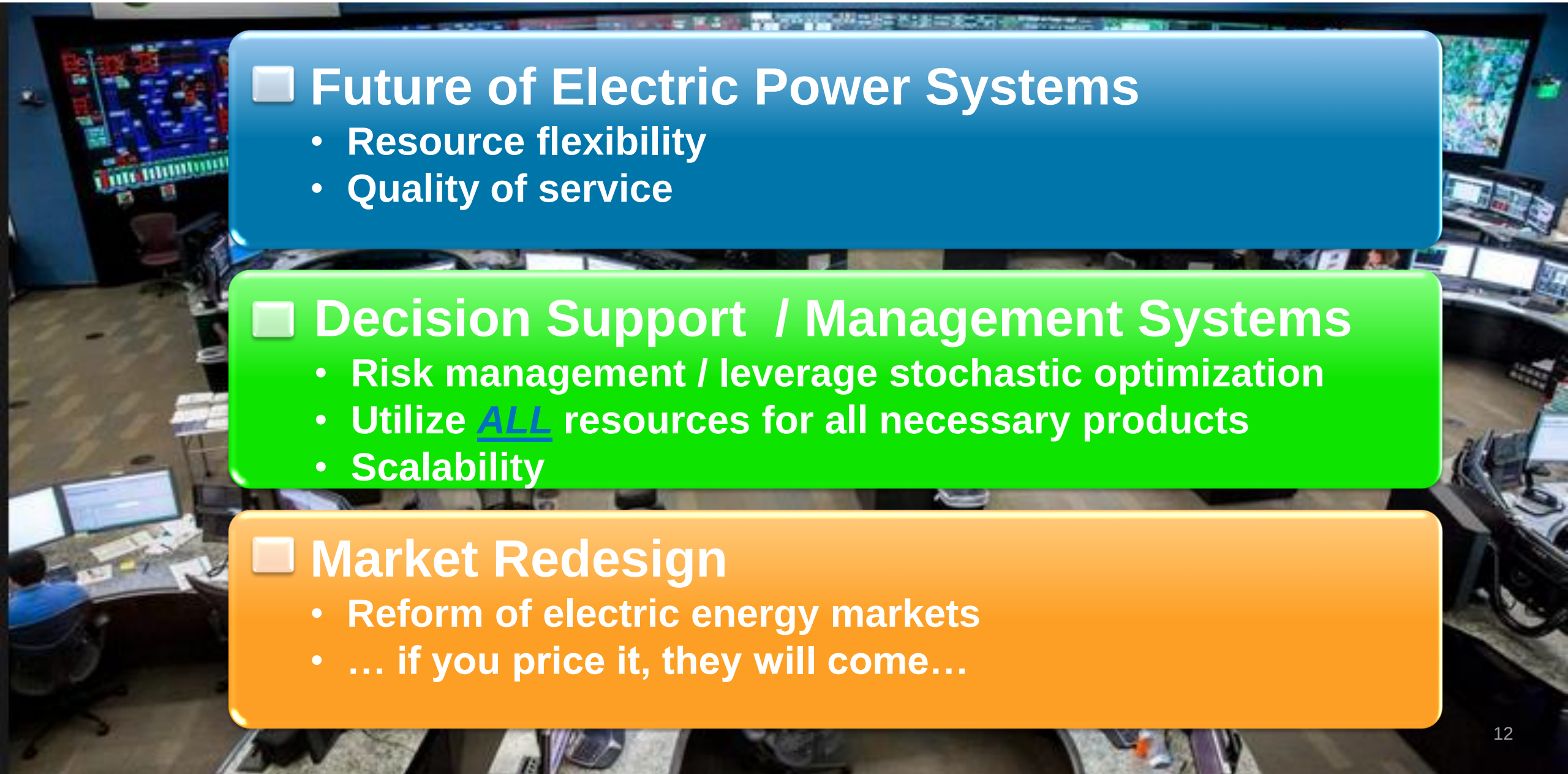
Net-Load

Utilize active Net-Load Control to provide low-cost ancillary services at different time-scales

Resource Management: Transition Renewables

Management Systems / Decision Support Tools

Areas for Innovation



Future of Electric Power Systems

- Resource flexibility
- Quality of service

Decision Support / Management Systems

- Risk management / leverage stochastic optimization
- Utilize ***ALL*** resources for all necessary products
- Scalability

Market Redesign

- Reform of electric energy markets
- … if you price it, they will come…

We seek your feedback and input!

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